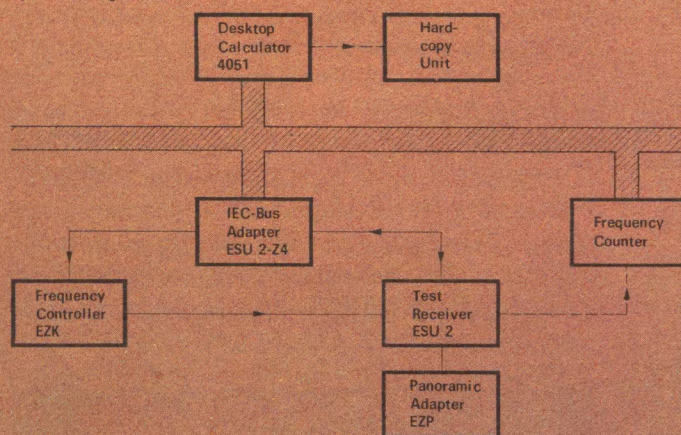


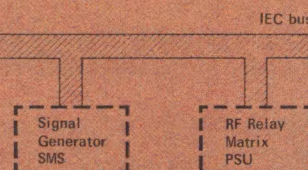
PROGRAMMABLE VHF-UHF TEST EQUIPMENT

25 to 1000 MHz
-10 to +120 dB(μ V)

System configuration



Extensions



PROGRAMMABLE VHF-UHF TEST EQUIPMENT MSUP

A wide range of measuring and evaluation capabilities

- | | |
|-------------------|---|
| Manual operation: | <ul style="list-style-type: none"> ● Rapid frequency selection, exact frequency setting ● Panoramic display (RF and IF analyses) ● Demodulation and aural monitoring facilities ● Outputs for connection of extension units |
| Computer control: | <ul style="list-style-type: none"> ● IEC-bus connector for control by standard desktop calculator ● Test Equipment can be readily extended by addition of further IEC-bus-compatible units ● Software available for Tektronix Desktop Calculator 4051 covering modular software and dialog programs for all typical applications with graphic display of test result ● When using the Tektronix Desktop Calculator 4051 connection of printer, plotter and hardcopy unit possible |

Characteristics and Uses

The compact, IEC-bus-compatible Programmable VHF-UHF Test Equipment MSUP, which can be manually operated or controlled from the Tektronix Desktop Calculator 4051, is suitable for many types of measurement, such as

Selective measurement of voltage, current and gain

Field-strength measurement in conjunction with test antennas according to relevant CCIR recommendations

Radiomonitoring with remote frequency measurement

Two-port gain and attenuation measurements, reflection-coefficient measurements using a VSWR test bridge

Interference measurements in line with MIL standards and VG regulations, CISPR and VDE.

Determination of antenna radiation patterns using IEC-bus compatible rotators.

The Programmable VHF-UHF Test Equipment MSUP consists of the following four units which are accommodated in a table-top rack, 11 dimensional units high:

IEC-Bus Adapter ESU 2-Z4,
Panoramic Adapter EZP,
Frequency Controller EZK and
VHF-UHF Test Receiver ESU 2.

The IEC-Bus Adapter contains all the functional groups required for bus control of the ESU 2 and the EZK. A built-in loudspeaker permits aural monitoring of the signals received by the ESU 2. Moreover, a Frequency Controller can be incorporated in the IEC-Bus Adapter ESU 2-Z4 for remote frequency measurements.

The MSUP may be controlled in two different ways:

1. Via IEC-bus 625-1

IEC-bus control of ESU 2 and EZK via the ESU 2-Z4; the Panoramic Adapter EZP is used for a visual

check of the frequency spectrum. Combined with the Tektronix Desktop Calculator 4051 the MSUP forms an all-purpose automatic test system for voltage, field-strength (using test antennas) and two-port measurements in the frequency range from 25 to 1000 MHz.

2. Manually

In the LOCAL mode the IEC-Bus Adapter ESU 2-Z4 allows the Test Equipment to be operated manually. A detailed description of manual operation is given in the data sheet of the Selective VHF-UHF Test Equipment MSU (253 202).

These two operating modes make the Programmable VHF-UHF Test Equipment MSUP suitable for all purposes. It combines the flexibility of a manually operated measuring system with the speed and accuracy of a computer-controlled system.

The combination MSUP + Tektronix Desktop Calculator 4051 provides a programmable VHF-UHF test system conforming with IEC 625-1 and IEEE 488. IEC-bus adaptation of the ESU 2 is accomplished by means of the **IEC-Bus Adapter ESU 2-Z4**.

The desktop calculator renders possible alphanumeric and graphic display of the test result on a storage screen and, moreover, permits extremely easy writing, testing and correcting of programs. The test result can be output to a printer or hardcopy unit.

The software available for the Test Equipment comprises the basic software with complete setting, checking, test and computing routines; with these it is no problem for the user to prepare his own programs, and – based on that – ready-to-use dialog programs for different applications.

The advantages of computer control, such as

- considerably reduced measurement time;
- automatic easy-to-evaluate printout;
- no operating errors,

make for the cost-effectiveness of the Test Equipment. The dialog programs are designed so that the Test Equipment can also be operated without errors by unskilled personnel.

The MSUP can be used wherever a large number of measurements need to be carried out, printed out and evaluated with always the same high accuracy and reliability. This is the case above all in measurements of the spectrum of wanted and interference signals.

The software supplied with the Test Equipment includes **dialog programs** for solving the most frequent measurement tasks.

A **search program** for radiomonitoring is used to measure within a specified frequency range the input voltages exceeding a preselected threshold value. With the aid of an IEC-bus-compatible frequency counter, the respective frequencies are determined with high accuracy. Another dialog program permits level and frequency measurements for **radiomonitoring** on fixed frequencies which are stored in a data memory in the calculator (Figs 1 and 2).

When **measuring EM interference according to MIL specifications and VG regulations** (Fig. 5), the test system permits separate detection of sinewave and wideband interference sources. Sinewave interference voltages not originating in the test item (e.g. picked-up broadcast signals) can be eliminated from the test result by a suitable program. The calculator-controlled measurement offers the advantage of higher accuracy over the conventional analog interference recording method; it is equal in quality – this also applies to the other application examples quoted here – to a correctly performed manual measurement.

In the case of **radio-interference measurements according to CISPR Publ. 2 and 4 and VDE 0875** (Fig. 3), this test system is the first to offer the possibility of automatically displaying the test results, both alpha-numerically and graphically, over a wide dynamic range. The peak hold period for each value can be set as required.

When **measuring the harmonics** of a signal or the **transfer constant** (attenuation or gain, Fig. 4) of two-port networks, the possibility of obtaining derived quantities by processing measured values (e.g. voltage ratios from voltages) offered by the computing system is a great help. During field-strength measurements, the computing system automatically considers the (frequency-dependent) antenna factor (k) so that direct reading and recording are possible.

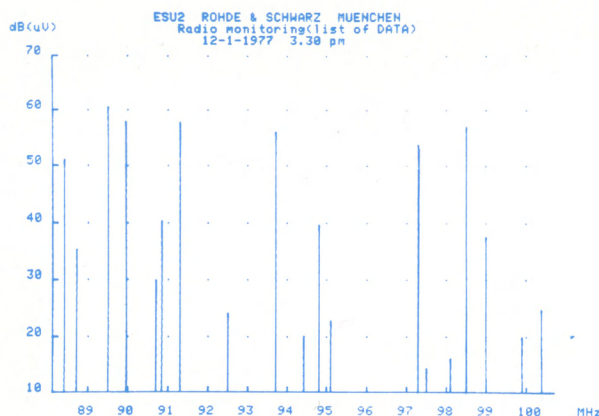


Fig. 1 Level diagram of measurement in VHF range (site: Munich) using "radiomonitoring (fixed frequencies)" routine

receiver-frequency/MHz	level/dB(uV)	measured frequency/MHz	frequency-difference/kHz
88.4	51.1	88.400083	0.083
88.7	35.2	88.700002	0.002
89.5	60.5	89.499991	-0.009
89.95	57.8	89.949996	-0.004
90.7	25.5	90.700004	0.004
90.85	40.3	90.849917	-0.003
91.3	57.7	91.300227	0.027
92.5	24.1	92.500102	0.002
93.7	56.1	93.700382	0.382
94.4	20.1	94.400044	0.044
94.8	33.6	94.800711	0.711
95.1	22.8	95.099902	-0.098
97.3	53.8	97.300038	0.038
97.5	14.2	97.499139	-0.861
98.1	16.1	98.099996	-0.004
98.5	57.1	98.500292	0.292
99.5	37.5	99.000727	-0.327
99.9	19.9	99.999902	-0.098
100.4	24.7	100.399845	-0.155

Fig. 2 Tabular data relating to measurement of Fig. 1

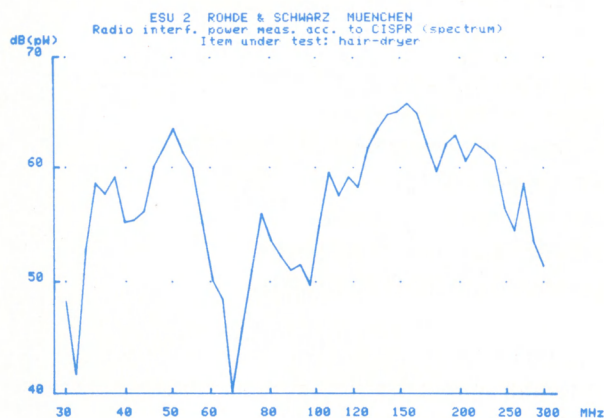


Fig. 3 Radio-interference power in range 30 to 300 MHz measured according to CISPR Publ. 2

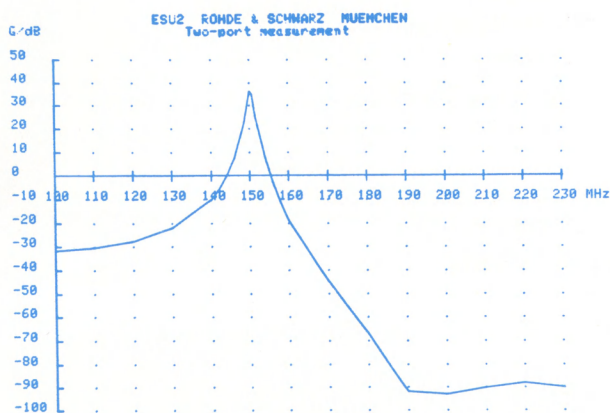
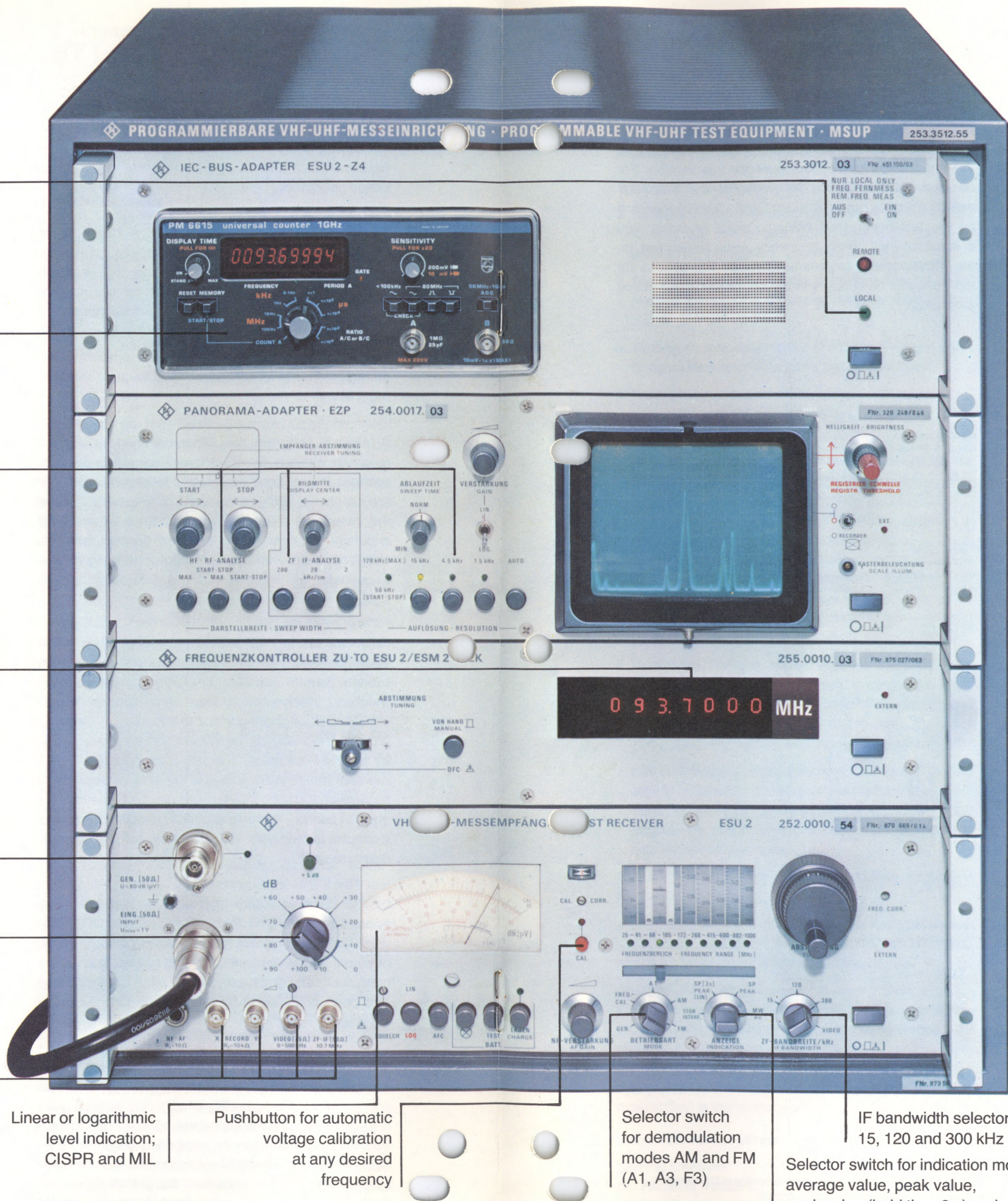


Fig. 4 Two-port measurement: characteristic of selective amplifier



Pushbutton
for switchover
to manual operation

IEC-bus-compatible frequency
counter for automatic remote
frequency measurements
(retrofittable)

Controls for RF and IF
analyses (5 different
resolution bandwidths)

Frequency readout,
resolution 100 Hz (setting
by means of coarse/fine
drive on the ESU 2,
by means of Kellog switch
on the EZK in DFC or automatic
operation from 25 to 1000 MHz)

Generator output
for two-port and remote
frequency measurements

Level selector
switch for measurement
range from
-10 to +120 dB(μ V)

AF, recorder
and IF outputs

Linear or logarithmic
level indication;
CISPR and MIL

Pushbutton for automatic
voltage calibration
at any desired
frequency

Selector switch
for demodulation
modes AM and FM
(A1, A3, F3)

IF bandwidth selector switch
15, 120 and 300 kHz
Selector switch for indication modes:
average value, peak value,
peak value (hold time 3 s) and
interference measurement (VDE, CISPR)

IEC-Bus Adapter
ESU 2-Z4

Panoramic Adapter
EZP

Frequency Controller
EZK

VHF-UHF
Test Receiver
ESU 2

Operation

In programmed operation, the test run is controlled from the keyboard of the desktop calculator. When the dialog programs, which are part of the software supplied, are used, the operator only has to respond to the queries appearing on the screen (see example given below). The switchover facility to LOCAL operation permits automatic measurements to be repeated manually.

With the aid of the basic software, the user can prepare his own test routines in BASIC language and these can be stored in magnetic-tape cassettes. A hardcopy unit, printer or plotter can be integrated in the test system. The calculator is programmed simply by inserting the cassette and calling the stored program.

A group of user-definable keys of the calculator can be used for special settings and measurement procedures that frequently reoccur.

Example: dialog for radio interference measurement program

Text of query	Response
Measurement of radio interf. field strength = 1 or radio interf. power = 2:	1
The program contains two antenna combinations: 1) Broadband Dipole HFU 2-Z1 (25 to 80 MHz) and Log-periodic Broadband Antenna HL 023 (80 to 1000 MHz) 2) Broadband Antenna BBA 9106 (Mfr: Schwarzbeck) for 30 to 300 MHz and Log-periodic Broadband Antenna HL 023 for 300 to 1000 MHz	
Enter your combination (1 or 2):	1
Observation time per meas. value (in seconds):	5
Test run: frequencies from data record = 1 or via keyboard = 2:	1
Test item:	Vehicle

With the dialog programs, the **test results** are displayed on the screen in graphical and/or tabular form (Fig. 5) permitting easy interpretation. Common to all dialog programs is that the voltage, field-strength or attenuation and frequency scales are optimally matched to the graphic readout without operator intervention. For two-port measurements, for instance, the calculator selects a display range between 1 and 150 dB depending on the test result, thus ensuring exact readings, and a linear or logarithmic frequency scale depending on the measurement requirements. Copy instructions for the Tektronix hardcopy unit are contained in the dialog programs.

```
Item under test: Vehicle
What is to be measured?      Fieldstrength=1
                               Voltage      =2
                               or Current   =3:1

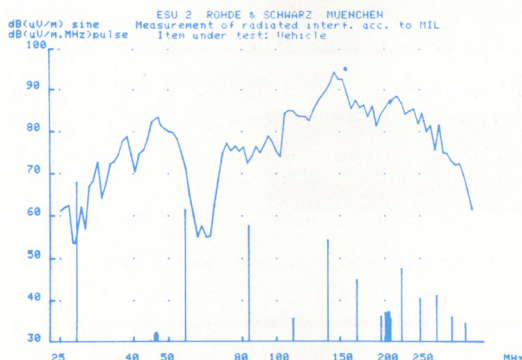
The program contains the antenna factors of the
Biconical Antenna (near field) and the Conical log spiral antenna.
When passing the frequency 200MHz a command
to change the antenna will appear.

Total range (25to1000MHz)    =1
or Section                   =2 :2

Start frequency/MHz:25
Stop frequency/MHz :350

Number of pulse interf. measurements within the given
frequency range (min.:2):100

Indication for meas. of pulse interf. LIN oder LOG:LIN
Shall narrowband interf. be meas. separately? Y or N:Y
Lower limit/dB(uV/m) for narrowband interf. to be recorded:35
```



ESU 2 RÖHDE & SCHWARZ MÜNCHEN
Measurement of radiated interf. acc. to MIL
Item under test: Vehicle

Pulse interference:

Frequency/MHz	Interf. level/dB(uV/m, MHz)
25	60.5
25.6754	62.3
26.369	62.7
27.0814	55.6
27.4877	56.8
28.5644	61.8
29.3361	58.5
30.1286	66.1
30.9425	71.5
31.7785	73.4
32.637	65.9
33.5187	65.6
34.4242	71.2
35.3542	73.4
36.3093	75.5
37.2903	78.8
38.2977	78.3
39.3323	71.5
40.3949	71.8
41.4852	72.4
42.607	73.0
43.758	75.8
44.9402	82.5
46.1543	84.1
47.4011	82.1
48.6817	82.6
49.9969	88.4
51.3476	88.0

ESU 2 RÖHDE & SCHWARZ MÜNCHEN
Measurement of radiated interf. acc. to MIL
Item under test: Vehicle

Narrowband interf. above 35.0dB(uV/m):

Frequency/MHz	Level/dB(uV/m)	Mounting of Biconical Antenna If mounted:RETURN
27.7826	68.8	
44.4968	30.1	
45.635	31.8	
45.9885	32.2	
46.2851	32.2	
46.5816	31.6	
55.5786	61.5	
83.357	57.7	
111.145	35.6	
139.3339	54.3	
166.7213	44.9	
194.5183	36.2	
200.1847	37.1	
200.4946	37.1	
200.7859	37.0	
201.085	36.5	
201.3847	34.9	
201.6861	36.6	
201.9858	36.7	
202.285	34.7	

Mounting of Conical log spiral antenna If mounted:RETURN

Fig. 5 EM interference measurement according to MIL standard:
(above) dialog program and graphic display
(superimposed sinewave and pulses);
(below) separate listing of sinewave and pulse interference

Software

The software of the test system is available as a magnetic-tape cassette and consists of **basic software** comprising complete setting, check-up, test and calculating routines and of **dialog programs**. The program texts are in German or English.

The following **dialog programs** are available:

1. **Radiomonitoring (fixed frequencies)** for measuring level at the frequencies stored in a data record or entered by the operator upon request.
2. **Radiomonitoring (search program)** for the automatic scanning of a frequency range and measuring the levels.
3. **Two-port measurement.** Frequency ranges with different frequency step sizes can be selected.
4. **Harmonics measurement.** The fundamental frequency is entered and harmonics can be measured up to 1000 MHz.
5. **Radio-interference measurement according to CISPR (fixed frequencies).** Measurement of continuous interference sources according to CISPR Publ. 2 and 4 and VDE 0875 at the frequencies stored in a data memory or entered by the operator on request. The time constant of the indicating meter, which is important for the correct weighting of pulses, is closely simulated. The maximum value is calculated within the observation time per measured value – entered by the operator – and output as the result in dB(μ V).
6. **Radio-interference measurement according to CISPR (spectrum).** Measurement of continuous interference sources according to CISPR Publ. 2 and 4 and VDE 0875 with the possibility of detecting sinusoidal and pulsed interference separately in the spectrum.
7. **EM interference measurement according to MIL and VG.** Separate detection of narrowband and wide-band interference is possible, peak value being indicated in dB(μ V/MHz). Field strength, voltage and current can be measured.

Programs 1 and 2 include the possibility of remote frequency measurement.

With programs 5 and 6 it is also possible to measure interference field strength with the help of antennas, and radio noise power using absorbing clamps.

For special applications and for measurements requiring additional instruments the user can compose a program within a few hours with the help of the **basic software**. It requires a storage capacity of 12 k bytes, together with the dialog programs (but without measuring data) 18 k bytes. A 24 k store at least (32 k with expanded test assemblies) is therefore necessary.

Basic software routines

Setting routines:

- 51 Receiver frequency
- 52 Receiver-frequency detuning
- 53 IF bandwidth

- 54 Indication mode
- 55 Operating mode
- 56 Lin/log
- 57 Squelch
- 58 AFC
- 59 Level-switch setting
- 60 Level calibration
- 62 Setting of DVM
- 63 Delay time/s
- 64 Setting of frequency counter
- 65 Basic setting (standard)
- 66 Basic setting (dialog)

Measuring, checking and computing routines:

- 72 Check level calibration
- 73 Check frequency setting
- 74 Measure and read out DVM
- 75 Measure without autoranging
- 76 Measure level lin, log; average value, peak value, peak value (3 s)
- 77 Measure level of interference acc. to CISPR and VDE 0875
- 78 Measure level of pulse spectral density acc. to MIL standards
- 79 Measure frequency offset of measured signal from receiver frequency
- 80 Antenna factor k of broadband dipole 25 to 80 MHz
- 81 Antenna factor k of log-periodic broadband antenna HL 023 80 to 1000 MHz
- 82 Antenna factor k of biconical antenna 20 to 200 MHz (far field) acc. to MIL-STD-461 A
- 83 Antenna factor k of biconical antenna (near field)
- 84 Antenna factor k of conical log-spiral antenna 200 to 1000 MHz acc. to MIL-STD-461 A
- 85 Measure received frequency (remote frequency measurement)
- 86 Antenna factor k of broadband antenna BBA 9106 30 to 300 MHz
- 87 Correction factor of Absorbing Clamp MDS-20 30 to 300 MHz
- 88 Correction factor of Absorbing Clamp MDS-21 30 to 1000 MHz
- 89 Transfer admittance (log) of RF Current Probe ESU-Z 25 to 300 MHz

Keeping to just a few variable names gives the user a lot of freedom in composing programs.

Program example (level measurement with result displayed on screen)

710 Y1 = 381	}	setting to 381 MHz
720 GOSUB 51		
730 Y = 1	}	delay time 1 s
740 GOSUB 63		
750 GOSUB 76		level measurement
760 PRINT Z1; "dB(μ V)"		display of results

For preparing larger programs and taking full advantage of the possibilities incorporated in the calculator the user needs a certain amount of knowledge – which he can easily acquire – of the BASIC programming language and of the Tektronix 4051 computing system.

Specifications

General data

Nominal temperature range	0 to +40 °C
Storage temperature range	–25 to +70 °C
AC supply	115/125/220/235 V +10/–15%, 47 to 420 Hz (180 VA)
Overall dimensions (W x H x D)	520 mm x 542 mm x 634 mm
Weight	72 kg

For more technical details of the Programmable VHF-UHF Test Equipment MSUP see the respective data sheets of the units.

Order designation

► Programmable
VHF-UHF Test Equipment MSUP

MSUP 25 to 1000 MHz (standard model)	253.3512.55
MSUP 20 to 1000 MHz	253.3512.52
MSUP 25 to 1000 MHz (only IF analysis)	253.3512.54
MSUP 20 to 1000 MHz (only IF analysis)	253.3512.51

Accessories supplied

4 power cords	025.2365.00
Battery cable for ESU 2	252.0084.00
Manual	

To be ordered separately, if required

Frequency Counter PM 6615/04 (Philips) with IEC-bus plug-in card PM 9676	please order from Philips directly ¹⁾
---	--

Recommended accessories

For connection of the frequency counter:

IEC-Bus Cable PCK (2 m)	292.2013.20
RF patch cord (2 x BNC connector, 50 Ω, 1 m)	100.6945.10
Adapter BNC female connector-N male connector	118.2812.00

Individually supplied units and options

IEC-Bus Adapter ESU 2-Z4	253.3012.02
Panoramic Adapter EZP	254.0017.02
Frequency Controller EZK	255.0010.02
VHF-UHF Test Receiver ESU 2	252.0010.55
3 patch cords (50-pole)	119.5250.00
For field-strength measurements (in place of ESU 2):	
VHF-UHF Field-Strength Meter HFU 2	253.0013.55
RF Relay Matrix PSU	290.8014.02
Signal Generator SMS (0.4 to 520 MHz)	302.4012.02
with Options:	
IEC Bus SMS-B4	335.0916.02
1.04-GHz Frequency-Range Extension SMS-B2	335.0016.02

Control unit

Tektronix Desktop Calculator 4051 with built-in display with 24-k store: Option 21 with 32-k store: Option 22 Magnetic-tape cassettes (5): 111-0680-01	
---	--

Software for controlling ESU 2 with Tektronix Desktop Calculator 4051

ESU 2-K1 (25 to 1000 MHz, German)	253.2516.04
ESU 2-K1 (20 to 1000 MHz, German)	253.2516.05
ESU 2-K2 (25 to 1000 MHz, English)	253.2616.04
ESU 2-K2 (20 to 1000 MHz, English)	253.2616.05
Software for other IEC-bus-compatible computers	upon request

¹⁾ It is also possible to use IEC-bus-compatible products of other make after changing the routines 64 and 85 of the software package. Performance specifications of frequency counter: 25 to 1000 MHz; 10 mV; class of accuracy 10⁻⁸. Incorporation in the IEC-Bus Adapter ESU 2-Z4 is then, however, not possible.

